Missouri Department of Natural Resources

Water Protection And Soil Conservation Division
Public Drinking Water Program

MODEL

Emergency Operating Plan
For Public Water Supplies

Water Source Emergencies – Groundwater

Before The Emergency (Vulnerability Assessment)

- General
- Security
- Power
- Telemetry/Controls
- Structures
- Contamination
- Transmission Piping

During The Emergency

After The Emergency

PUBLIC WATER SYSTEM
MODEL EMERGENCY OPERATING PLAN

WATER SOURCE EMERGENCIES - GROUNDWATER

The most common problems with a groundwater source in emergencies are:

X loss of power
X loss of telemetry
X structural damage to well casing or housing
X contamination
X loss of water transmission lines from the well field

BEFORE THE EMERGENCY (VULNERABILITY ASSESSMENT)

Before an emergency, think about how your wells may quit working in an emergency. The questions below should help you find weak areas. Think about what you can do to improve these areas. Some areas can be helped by asking others to borrow equipment. Other areas will need physical improvement. Plan to do these system improvements over the next few years. You need to have a plan for what to do until the improvements are built.

General

Are your wells susceptible to natural and human-caused hazards such as drought, earthquake, flood, tornado, winter storms, security threats, contamination, or nuclear release? _____

_____

Where are drawings or information about the wells and well field kept? List building location and the location in the building or use the *Maps* section to list locations. _____

_____

Where is a sketch of how to get to the wells? The *Maps* section is a convenient place to keep these kinds of sketches. _____

Are wells installed in liquefiable soils or soils subject to lateral spreading caused by earthquakes that could bend the casing? _____

Is the liquefiable soil layer stablized, a double well casing used, and a submersible pump used to prevent damage to the well during an earthquake? _____

Are well screens used to avoid sand entry problems with slotted casings? _____

Are wells installed in deep aquifers when possible to avoid problems with earthquake damage?

_____

Are drawings and information stored above flood levels and in fire-protected area? _____

_____

What is the elevation of the top of the well casing? _____

What is the elevation of the top of the vent? _____

What is the elevation of the top of the well cap? _____

How will you get to the wells in a flood or other emergency? _____

Do you have alternative routes? _____

Where are boats and 4-wheel drive vehicles kept? _____

Do you have alternative raw water sources? _____

Are emergency water supply interconnections with other water utilities in place? _____

_____

Is there redundancy in the pumping system? _____
Do you know where to get correctly sized pumps if needed in an emergency? _____

Security

Are restricted areas posted with "Employees Only" or Restricted Area" signs?

_____

Is access to well field (or individual wells) restricted by fence, locked gates, well house, alarms, or other physical barriers? _____
Are only authorized personnel given access keys or codes for locked facilities? _____
Who has keys to locked facilities? _____
Are locks tamper-proof? _____
Where are duplicate keys or codes located? _____
Is adequate exterior or interior lighting in place? _____
Is well field (or individual wells) monitored? _____
By utility staff / intrusion alarms / television monitors? _____
Does staff vary security checks to the well field to avoid predictable patterns? _____
If alarm is activated, what is the response plan? _____
Do local law enforcement personnel perform regular security checks? _____
Are local homeowners/landowners aware of need for security with telephone number(s) to call to report suspicious behavior? _____
Are procedures in-place when specific security threats are issued by local/national law enforcement authorities? _____

Power

What are the power sources? _____
Have you coordinated with electric utility for priority feed to wells? _____
Do you have an emergency generator that can be used for the wells? _____

Where is this generator stored? _____
Are generators exercised regularly?

_____

Who knows how to operate the generator? _____
Where are the directions (operating manual) for the generator? _____
Where is the fuel kept? _____
Where do you buy fuel? _____
Where can you get a generator if you do not have one? _____
Where are the electric lines? _____
Where is the meter for each well? _____
Are the meters below the 100 or 500-year flood level? _____
Is the substation feeding the wells in the 100 or 500-year floodplain? _____
Have you talked to the power company about how they will supply power during a flood? _____
How will they supply power? _____
What electrical equipment is below the 100 or 500-year flood level? _____

Other than submersible pumps, how will you protect this electrical equipment from flooding?

Telemetry/Controls

Are controls automatic and/or by telemetry? _____
How will the well be controlled if telemetry is lost? _____
If you will need to control the well locally, how will you get to the well? _____
_____
Are SCADA system sensors operational and tested? _____

Structures

Is there a well house? _____
Is the structure constructed of fire-safe building material? _____
Is reinforced masonry and other hazard-resistant construction used? _____
What is the condition of the well house? _____
How will you protect the well house if there is a flood? _____
_____
Will you need sump pumps to keep the well house dry? _____
Where can you get a sump pump? _____

Contamination

Is a contamination monitoring system in place, operational and tested?
_____
Do you monitor pH, turbidity, total and fecal coliform, total organic carbon, ultraviolet absorption, color and odor of source water? _____
Are wells adequately setback from potential contamination sources?
_____
What will you do if there is a security threat/violation? _____
Is the casing above the 100 or 500-year flood level? _____
How will you protect the well if there is a flood? _____
Can you cap the vent? _____
What is the condition of the grout? _____
How will the grout protect the well in a flood? _____
What is the condition of the sanitary seal? _____
Does the well cap give a good seal? _____
If not, how will you seal the well from flood waters and other foreign materials? _____
_____
Is there chemical feed at the well? _____
How will the chemical feeder be controlled if there is a loss of telemetry? _____
_____
What happens if the chemical feed quits? _____
How will you deliver chemicals to the well if roads are inaccessible? _____

What will you do if there is a chemical overfeed or a chemical spill? (see Appendix J for chlorine or Appendix K for other chemicals) _____

Transmission Piping

How many pipelines come from the well field? _____
Is there redundancy in the system? _____
Are there isolation valves on each line? _____
Where are the isolation valves? _____
Are the isolation valves marked on any drawings? _____
How will valves be located and operated during high water or when covered with debris? _____
_____
Are there air and vacuum valves? _____
What are the elevations of the air valves? _____
Can they be flooded, letting sand and silt clog the valve and get into the raw water line? _____
_____
How will you protect the air and vacuum valves? _____
What are the elevations of the control valves? _____
Are the valves and valve pits protected from flooding and tampering? _____
How? _____
Are valves regularly operated and maintained? _____
Is piping flexible to allow for ground movements? _____
Are piping buried below the frost depth (typically 3 feet for Missouri)? _____
Are valves, sleeves, clamps and piping spares available for an emergency? _____
Are piping adequately setback from sewer lines or other sources of contamination? _____
_____

DURING THE EMERGENCY

The damage assessment form at the end of this section can be used to evaluate the condition of the wells during an emergency.

Always check for safety before doing anything!

What needs to be done in an emergency:

X If unauthorized intrusion is evident, notify law enforcement, determine type of security threat and respond accordingly.
X Coordinate alternative water supply if necessary.
X Increase sampling efforts if contamination is threatened.
X See the treatment responses for various contamination in *General Procedures for Specific Emergencies* under Contamination.
X Know current flood level and predicted flood crest.
X Compare elevations of all wells and well housings and roads to the predicted flood levels.
X Sandbag before flood levels threaten a well or well housing. Use a ringdike when sandbagging.
X Make sure power will be available during any emergency.
X Get generators if needed. The emergency form lists where to get generators (also refer to information in Appendix D).
X Get extra chemicals if roads or bridges will be inaccessible.
X Seal wells at cap and vent tube if they will be overtopped by flood waters.
X If a well will be overtopped by flood waters, turn the power to that well off.
X Get boats or 4-wheel drive vehicles if they might be needed. The emergency form lists where to get these. There is also information in Appendix G.
X Call MDNR for advice and to tell them what is happening. (Phone number is on emergency form or in Appendix A.)
X If an emergency is threatening all wells, get another water supply. The emergency form should list where you can get tank trucks and potable water or where you can get bottled water. If the sources you prepared for in advance are not available, use Appendix H to find another source.
X Call MDNR and tell your customers about the need or possible need for using another supply.
X Keep track of all emergency related labor hours and work repairs performed. Take pictures of all damaged to facilities and building contents.

AFTER THE EMERGENCY

The first thing to do after an emergency is check the condition of the wells, well housings, and raw water pipelines and power supply. A form for damage assessment is at the end of this section.

When doing a damage assessment, always check for safety before going in a building, driving to the wells, or getting out of a truck or car.

The damage assessment should cover:

X security
X power supply
X controls
X well casing, cap, sanitary seal, and vent tube
X well housing
X visible signs of contamination
X raw water pipeline

If you can see possible contamination at the well or if the well was overtopped by flood waters, turn the well off if it is still running. Call MDNR (phone number on emergency form).

Once damage assessment for the entire system has been done, repair work can be prioritized and repair work can begin.

Repairing a damaged well or cleaning a well filled with silt and dirt should be done by a certified well contractor. A list of contractors is in Appendix E or look on the Emergency Form.

A well that has been overtopped with floodwaters will need disinfection. General guidelines for disinfecting a well are (portions are adapted from a Department of Health Fact Sheet):

X Pump well for 48 hours to clear river water and sediment
X Disinfect well and let stand for 12 hours or more (50 ppm of chlorine for heavy contamination, 5 ppm for routine disinfection)
X Pump until you can=t smell chlorine
X Take samples for bacteriological testing
X Retest in three days
X Repeat if necessary

Note that pipelines will probably also need disinfecting (See Water Distribution Emergencies).

To determine the well volume for disinfection:

Gallons in well = 0.041 x D x d x (wd - swl)

Where D = Diameter of drilled hole, in inches
d = Diameter of casing, in inches
swl = static water level in well, in feet from top of well
wd = well depth, in feet from top of well

If D is unknown, use D = d + 18

For example, a well with a 12-inch casing, static water level of 20 feet and depth of 50 feet:

Gallons in well = 0.041 x (12+18) x (12) x (50-20)= 443 gallons

Table M-1 gives information on disinfection materials. Specific directions for disinfecting are after the table.

Table M-1
Disinfection Material

Disinfection material	% Chlorine in Material	Amount to add per 1000 gal to get 50 ppm chlorine	Amount to add per 1000 gal to get 5 ppm chlorine
Sodium Hypochlorite (liquid laundry bleaches like Clorox or Purex)	5.25	1-gallon	1 2 cups
Sodium Hypochlorite – commercial strength	12	7 cups	3/4 cup
Chlorinated lime (powder)	25	3 2 cups	5 tablespoons
Calcium Hypochlorite (B.K. powder	50	1 2 cups	2 2 tablespoons
Calcium Hypochlorite (H.T.H. Perchloron, etc.)	70	1 1/8 cups	2 tablespoons

If a powdered or granular compound is used, blend the material with water until you get a smooth paste. Let this mixture settle, then filter the liquid through a finely woven cloth. The disinfectant is then ready to add to the water supply.

If a liquid compound is used, the needed amount should be mixed in one or two gallons of water, and poured into the well. If possible, the water should be stirred to aid mixing of the disinfectant. This may be done by recirculating the water back into the well with the use of a garden hose or other pipe.

The liquid or powdered material may not reach the bottom of a deep well in a large enough quantity to be effective. Calcium hypochlorite in tablet form will sink to the bottom of the well before dissolving and is preferable in this case

Cautions in using disinfecting materials:

X The dust of powdered and granular products is extremely irritating to the lungs. Use precautions so that the dust is not inhaled.

X Chlorine-bearing compounds are strong bleach agents and should not touch clothing.

X Prepare chlorine-bearing compounds in clean containers; grease or oil in a container may react violently with the chlorine.

X Chlorine compounds may cause skin irritation. Wash the skin with water as soon as possible after contact.

X Read product labels and strictly observe all statements of caution.

After the emergency is over, damage are assessed and repairs are complete, apply for financial assistance (see Appendix N).